Responsible Research and Innovation: Guidelines on Good Research
Practice

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Responsible Research and Innovation: An Introduction

Society is currently facing many grand challenges, for instance: issues concerning sustainability, food security, population health, and wellbeing. Addressing such grand challenges require complex solutions that consist of coordinated and collaborative effort (Eisenhardt, Graebner & Sonenshein, 2016; Ferraro, Etzion & Gehman, 2015). Therefore, grand challenges stand to gain from the insights and achievements of research and innovation (Stahl, 2013). But despite science and technology's promising ability to address grand challenges it is impossible to predict how these will turn out due to the uncertainties of the future. Even though we might not be able to predict its outcomes, we can ensure that the process of conducting research and innovation is done responsibly. Such as, allowing it to be more open and transparent, reflective and reactive to social needs and expectations, and more inclusive to different views, expertise, and opinions (RRI-Tools).

During the last ten years, the term *Responsible Research and Innovation* (RRI) has increasingly gained attention by both researchers and European policymakers due to the wide adoption by the European Commission's programme for Research and Innovation "Horizon 2020" (H2020) (Owen, Macnaghten & Stilgoe, 2012; von Schomberg, 2013). RRI fosters ways of governing science and technology that are planned, designed, and implemented for and with society, engaging all actors in decisions (RRI-Tools, 2020).

RRI: an Evolving Concept

Despite having a fairly extensive history, a survey from 2017 revealed that among roughly 3100 researchers receiving H2020 funding, most were unaware of the concept (Novitsky, Bernstein, Blok, Braun, Chan, Lamers, Loeber, Meijer, Lindner & Griessler, 2020). Because of this and the lack of an agreed-upon uniform understanding (Burget, Bardone & Pedaste, 2015; Owen, Stilgoe, Macnaghten, Gorman, Fisher & Guston, 2013; Rip, 2016; von Schomberg, 2013), Novitsky and colleagues (2020) argue that the RRI framework is still evolving.

RRI definitions often differ in emphasis, terminology, orientation, and depth (Wickson & Carew, 2014). This lack of clarity has subsequently resulted in a variety of flexibly interpretable definitions that leave actors unaware of its specific meaning (Rip, 2016; Wickson & Carew, 2014). However, most definitions do overlap in some areas suggesting a somewhat shared understanding of RRI, encompassing the following characteristics:

1. *A focus on addressing significant socio-ecological needs and challenges;*
2. *A commitment to actively engaging a range of stakeholders for the purpose of substantively better decision-making and mutual learning;*
3. *A dedicated attempt to anticipate potential problems, assess available alternatives and reflect on underlying values, assumptions and beliefs; and*
4. *A willingness among all participants to act and adapt according to these ideas.*
   (Wickson & Carew, 2014, p. 255)

As a result of being broadly interpretable, RRI is said to be difficult to operationalise and is, therefore, criticised for not providing sufficient guidance to apply in practice (Owen et al., 2013; von Schomberg, 2013). This supports and highlights the need for guidelines and recommendations of RRI's practical application in order to bridge the gap between RRIs meta understanding and its practical governance.

Guidelines on RRI: Purpose & Structure

The purpose of this particular document is to present members of the research community with relevant information on why to engage with RRI through identifying and explaining different aspects that give depth to the concept. This will increase RRI awareness and explain how to practically engage with the concept. This is done by providing recommendations on relevant resources, tools, self-assessment questions, and

actions for improvement in the appendices.[1] The objective is to make RRI a strategic concern by revealing how to embed it throughout the research process (Novitsky et al., 2020)

The structure of the document is as follows: first, the importance of applying RRI in consumer science is briefly explained. Secondly, RRI is explained in further detail by identifying processual and conceptual dimensions. These dimensions make the concept more concrete and give direction to the various recommendations that are done in the appendices. After which, RRIs relation to Open Science and the FAIR data principles is discussed. Lastly, it is shared how we as researchers of Wageningen Economic Research include RRI, OS, and the FAIR data principles in our own work.

Together, these different sections reveal how engaging with RRI contributes to a more sustainable way of doing research better suited to societal needs by adopting a long-term perspective, involving all actors, and emphasising diversity, inclusion, openness, transparency, reflection, and adaption to changes.

RRI in Consumer Science

Although adopting RRI practices is important for the whole research community, the following section highlights its importance for the multidisciplinary field of consumer science.

Consumer science aims to understand the cognitive, affective, and behavioural tendencies associated with purchasing, using, and disposing of products and services (Romano, Risitano & Quintano, 2018). Depending on what is done with the theoretical and empirical findings, consumer science can harm or benefit society and its members.

Namely, consumer science can be used to predict how (new) products and services are adopted. This offers the opportunity to accelerate the process of product adoption (Rogers, 2003 [1965]). If this is being used to sell more products in order to generate more money with little to no regard for society or the environment, consumer science only benefits a minority of stakeholders and might even cause harm. However, this is not always the case. There are many examples of private commercial driven efforts that 'lead to innovative and effective controls to improve and sustain new standards for living' (Sibbel, 2003). Especially, if it involves diverse actors – such as consumers, researchers, health organisations, business innovators and governments – to contribute in synergistic ways.

In order to achieve this, it is important to engage with RRI measures. To increase knowledge about consumer science among members of society. This will enable people to participate in the process of research and innovation and encourage more collaboration and shared responsibility for the development of products and services. Together, the diverse stakeholders can ensure the research and innovation is carried out ethically and contributes to a desirable, healthy, and sustainable future. Providing early on access and considering diversity and inclusivity will contribute to the quality of the research and innovation process and outputs.

Research related activities in consumer science that would benefit from RRI are:

- Setting up a participatory research agenda,
- Incorporating RRI in funding calls and project proposals,
- Creating community-based participatory research

Like consumer science, RRI is both done *with society*, through collaboration, and *for society*, anticipating a desirable future that is adaptable to change (Von Schomberg, 2013). This is not something that is done overnight, active collaboration with many different stakeholders requires an open mind for different perspectives and well-developed dialogue and deliberation skills. But most important: the art of listening.

In the next section it is explained which dimensions should be considered during the process of doing research and innovations and what thematic elements researchers should pay attention to.

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[1] The recommendations are largely based on information provided by 'RRI Tools', an EU project aimed at raising awareness, training, and disseminating and implementing RRI.

RRI Application: Desired Outcome, Process Dimensions, and Focus Areas

RRI goes beyond the premise to act responsibly and do no harm, it aims to have a beneficial societal impact (Fitjar, Benneworth & Asheim, 2019; Owen, Macnaghten and Stilgoe, 2012). It strives for shared responsibility by engaging all actors. However, it is important that these actors – researchers, policymakers, educators, business and industry innovators, and civil society organisations – reflect on their role concerning science and technology. In some instances, it will be necessary to change the way these actors fulfill these roles and how they are embedded in society (Rip, 2014), to be better equipped to respond to societal changes and make technology and science more socially beneficial, ethical and sustainable for all.

The following sections on the process and conceptual dimensions are intended to provide a general understanding of what actions and subjects actors in society should engage with when conducting research and innovation. Here, no distinction is made yet between how different actors can engage with RRI. However, in appendix II you can find how these dimensions are translated into concrete actions for improvement.

Process Dimensions of Doing Responsible Research and Innovation

Stilgoe, Owen, and Macnacghten (2013) have identified four dimensions that form a framework for raising, discussing, and responding to questions that have emerged within public debates about areas of science and technology: anticipation, reflexivity, inclusion, and responsiveness. These dimensions have been adopted and adapted by the European Commission, resulting in the following:

DIVERSE AND INCLUSIVE
To produce outcomes that align with the values and expectations of society, all of the groups involved in and affected by research and innovation need to work together. Voices across a diversity of communities should be involved in research, from its beginnings to its commercialisation. Different perspectives and expertise generate higher quality science and ensure all points of view are taken into account.

OPEN AND TRANSPARENT
RRI is also about achieving a more knowledge-based society. This means making the process of research and innovation more transparent and open to all actors, providing them with meaningful information during all stages of the process. This encourages all actors and the public to engage with, discuss and scrutinise science and technology, which empowers people to make more informed decisions.

ANTICIPATIVE AND REFLECTIVE
Responsible actors consider not just the immediate impacts of their work, but look ahead and reflect on the kind of future they are trying to build. This means considering why this is a desirable future, how it will be achieved, and any possible unintended consequences that may arise along the way. Anticipating the possible impacts and reflecting on the underlying assumptions, values and purposes of research and innovation generate useful insights that allow more responsible action.

RESPONSIVE AND ADAPTIVE TO CHANGE
Finally, research and innovation must respond to the views expressed by the public and other stakeholders and, if necessary, methods or goals should be changed. The ability to adapt as a result of different views, changing circumstances or fresh knowledge is the final process dimension of RRI.

Figure 1. Process Dimensions of Doing Responsible Research and Innovation as Identified by RRI Tools.

These dimensions provide more depth to the concept of RRI. It emphasises how the process of research and innovation can ensure more responsible outcomes, rather than a specific outcome in itself (Burget, Bardone, and Pedaste, 2017). Incorporating these dimensions into the processes of different actors in society will in certain instances require institutional and subcultural changes (Burget et al., 2017). E.g.: business and industry innovators might not be used to or comfortable with opening up their innovation process due to its believed threat to their competitive advantage. Or researchers might not anticipate possible negative implications resulting from their research output, due to their focus on conducting research rather than its consequences.

Conceptual Dimensions of Doing Responsible Research and Innovation

In addition to these process dimensions, the European Commission has identified six thematic elements it aims to further ("Regulation (EU) No 1291/2013," 2013): ethics, gender equality, governance, open access, public engagement, and science education.

ETHICS	GENDER EQUALITY	GOVERNANCE	OPEN ACCESS	PUBLIC ENGAGEMENT	SCIENCE EDUCATION
Ensuring research integrity, and science & society	Promoting human resources in research for attaining gender balance	Providing instruments to foster shared responsibility in R&I practices	Guaranteeing access to scientific knowledge to boost R&I	Fostering collaborative and multi-actor processes in R&I	Increasing the knowledge and skills of citizens in order to promote scientific vocations and participation

Figure 2. Conceptual Dimensions of Doing Responsible Research and Innovation

These conceptual dimensions have been criticised for having 'more to do with the bureaucracy of maintaining [RRI] as a cross-cutting theme [in the Horizon 2020 programme] than with the conceptual foundations of RRI' (Rip, 2016, p. 292). Since it focuses on concrete themes it may come across as if the conceptual dimensions are about *what* is achieved rather than *how*. However, in order to carry out research and innovation responsibly, the process of achieving certain outcomes are just as important, if not more than the outcomes themselves. That means that if you are fostering collaboration, increasing the number of actors involved has more value when it is achieved through being inclusive, transparent and anticipative Only then is public engagement achieved responsibly.

These conceptual dimensions allow actors to use, focus and direct process dimensions towards concrete topics. Therefore, making the process dimensions less vague and more practically applicable. For instance: Encouraging critical peer review and internal discussion on research integrity throughout the process of doing research requires actors to be transparent, reflective and responsive. This combines several process dimensions with the conceptual dimension ethics. Another example: discussing what can be done to avoid gender stereotypes s centres around diversity, inclusiveness reflection, and responsiveness in order to increase gender equality.

It is impossible for the six conceptual dimensions to fully cover the breadth of topics where more responsible research and innovation is needed. Burget et al. (2017) propose to add care and sustainability to the list. However, they do offer a good starting point, meaning that engaging and improving on these aspects does contribute to doing more responsible research and innovation. In our view the conceptual dimensions are not set in stone and should instead be regarded as dynamic components of RRI, allowing the possibility of adding subjects that require more attention. Such as care and sustainability, as proposed by Burget et al. (2017)

RRI, Open Science, and the FAIR Principles

Other concepts used by the European Commission that are related to the dimensions of RRI are Open Science (OS) and the FAIR data principles. In the following section, these concepts and their added value for RRI are explained.

Beyond Open Access: Open Science Guided by FAIR Data Principles

OS is the term used by the European Commission to describe '*the ongoing transitions in the way research is performed, researchers collaborate, knowledge is shared, and science is organised. It represents a new approach to the scientific process based on cooperative work and new ways of knowledge distribution using digital technologies and new collaborative tools*.' (Open Science Policy Platform, 2020). It is believed that OS will make science more: credible, reliable, efficient, and responsive to societal challenges (Open Science Policy Platform, 2020). Therefore, it fits well with the purpose of RRI.

Both RRI and OS demand methodological, behavioural, institutional and structural change to achieve societal good, using a combination of scientific and technical processes. But whereas RRI focuses on societally and ethically 'good' outcomes, OS concerns itself almost entirely with outcomes that are functionally and epistemically 'best' (Shelley-Egan, Gjefsen & Nydal, 2020, p. 11). Relating OS to the different dimensions that make up RRI, it mainly shares similarities with the process dimensions:

transparency and responsiveness, and the conceptual dimensions: ethics and open access. However, open science goes beyond RRI's open access. Because even though technological developments in information and communication form a major part of enabling open access, open science can't succeed without also having open research data (Burgelman, Pacu, Szkuta, Von Schomber, Karalopoulos, Repanas & Schouppe, 2019).

Open research data impacts a number of things, such as the detections of false claims, inaccuracies, and performing replicability tests (Burgelman et al., 2019). In addition, it is believed that open research data stimulates multidisciplinary efforts through shared use of data. Such possibilities for multidisciplinary collaboration may broadens research scopes, and subsequently encourages the inclusion of diverse (multidisciplinary) perspectives (Burgelman et al., 2019; Fischer & Zigmond, 2010). As a result, it allows for the development of new (meta) knowledge (Burgelman et al., 2019; Evans & Foster, 2011). Because it positively affects and reinforces the areas RRI aims to improve, OS is a great addition to engage with.

However, implementing the measures that will facilitate the change towards open research data will require coordinated effort in order to prevent discrepancies and a lack of synergies between the different repositories that host data (Burgelman et al., 2019). That is where the FAIR data principles come in. The FAIR data principles represent 'a minimal set of community-agreed "aspirational" guidelines for the publication of digital resources such as datasets, code, workflows, and research objects, to achieve a state of "FAIRness"' (Burgelman et al., 2019, p. 3). FAIRness represents the findability, accessibility, and interoperability of data and services in order to serve the ultimate goal of being able to reuse valuable research objects (Mons, Neylon, Velterop, Dumontier, da Silva Santos & Wilkinson, 2017).

While open research data will need to comply with the FAIR principles for OS to be achieved, FAIR is not equal to open. National security, personal privacy, and competitiveness are examples of legitimate reasons for shielding data and services even if the data has been generated with public funding and public access (Mons et al., 2017). Instead of being open or free FAIR requires access and reuse of data and services to be clear and transparent.

When the FAIR data principles are adhered to it is believed they will lead to:

- *reduced costs (for producing and managing data);*
- *improvement of the data quality and of the demonstrability of high quality and integrity of the data;*
- *availability of reliable data in real-time;*
- *reduction in the time between monitoring and action;*
- *more scientific research re-using available databases and using data in new combinations.*
- *building of public trust in the data, and expansion of the people's ability to use them*
  (Rychlik, Zappa, Añorga, Belc, Castanehira, Donard, Kourismká, Ogrinc, Ocké, Presser & Zoani, 2018, p. 3)

These outcomes reveal a positive and reinforcing effect on several areas identified by the European Commission to achieve responsible research and innovation. Therefore, adopting the FAIR principles and adhering to OS when that is possible, greatly contribute to researching and innovating in a responsible manner.

Open Science and the FAIR Data Principles: Economic Impact

Some research institutes or private commercially driven companies might instinctively regard OS and the FAIR data principles as a restriction on the valorisation opportunities they require to earn back on their monetary and knowledge investments. However, Fell (2019) reveals in his Rapid Evidence Assessment (REA) that open access to research findings and data can lead to positive economic impact. The REA reveals that this is achieved through efficiency and enablement.

On the one hand, efficiency refers to achieving the same output from research or innovation for less input (Fell, 2019). For instance, through saving costs concerning journal and research data access, (text and data mining) transactions, and associated labour.

On the other hand, enablement 'signifies ways in which open science approaches have led to economically impactful activities which would have been likely to occur in a closed environment', such as new products, services, collaborations, and companies (Fell, 2019, p.10).

However, the evidence to back up this positive economic impact remains 'patchy and diverse' as available and comparable data is missing on the actual use of OS outputs (Fell, 2019). Therefore, more research, monitoring, and evaluation is needed to identify the economic impacts of OS and the FAIR data principles. Without a clear understanding of how positive economic impact can be achieved, it's difficult for research institutes and private commercially driven companies to design effective support policies to make use of OS and the FAIR data principles in a beneficial manner. Indicating that their concern on valorisation is valid.

In Conclusion

RRI has gained wide importance among several actors in society and the European Commission aims to increase this through structural implementation. In this document several processual and conceptual dimensions were elaborated on that contribute to a better understanding on how to engage with RRI. Additionally, in the appendices several tools, resources, self-assessment questions, and actions for improvement relating to these dimensions were presented to assist the research community in the practical application of RRI. This reveals that a lack of an agreed-upon definition doesn't have to stop you from engaging with RRI even though it does reflect that the concept is still under development.

As researchers we should find ways to govern early-on participation from diverse actors in order to make the research and innovation process better suitable for tackling grand challenges and responding to societal needs. Engaging in RRI will stimulate ways of researching that adopt critical long-term perspectives about how we want to shape the world. It will contribute to redefining our role as researchers and further the discussion on how we want science and society to interact. By emphasising diversity, inclusivity, openness, transparency, anticipation, reflection, responsiveness, and adaption to change – RRI will strengthen research projects that are better suited to societal needs. Let's make RRI a strategic concern among the entire research community.

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Appendix I: Tools and Resources

Subject	Tools & Resources	About	Source
General	Responsible Research and Innovation: A Quick Start Guide for Science Engagement Organisations	Making science engaging is vital work, but fraught with challenges. How do you stay relevant in your local community? How do you ensure activities are designed in a way that places the needs and preferences of multiple target audiences at their centre? How do you find new collaborators and effectively expand your network? If you work for a science engagement organisation and need some support or just a little direction, this quick start guide to Responsible Research and Innovation (RRI) will help.	https://www.ecsite.eu/sites/default/files/quick_start_guide_in_rri.pdf
	Engage2020 Action Catalogue	The Engage2020 Action Catalogue is an online decision support tool that is intended to enable researchers, policy-makers and others wanting to conduct inclusive research, to find the method that is best suited for their specific project needs. The Action Catalogue is made easily searchable, so as to make finding the method best suited for a project, intuitive and fast.	http://actioncatalogue.eu/search
	A report on Responsible Research & Innovation	RRI is about trying to get better at anticipating problems, taking into account wider social, ethical and environmental issues and being able to create flexible and adaptive systems to deal with these unintended consequences. This is sometimes called 'Anticipatory Governance'. RRI aims not to be a barrier to innovation but a stimulus for success. Growth based on genuine innovation; which brings to life sustainable development and involves society in the creation of its vision, the articulation of its values and the shaping of its products will allow Europe to be a hub of innovation for the benefit of us all.	https://ec.europa.eu/research/science-society/document_library/pdf_06/rri-report-hilary-sutcliffe_en.pdf
Ethics	European Code of Conduct for Research Integrity	The European Code of Conduct for Research Integrity serves the European research community as a framework for self-regulation across all scientific and scholarly disciplines and for all research settings.	https://ec.europa.eu/research/participants/data/ref/h2020/other/hi/h2020-ethics_code-of-conduct_en.pdf
	Training and Resources in Research Ethics Evaluation (TRREE)	TRREE is a set of resources aimed at providing basic training and building capacities on the ethics of health research involving human participants so that such research will meet the highest ethical standards and will promote participants' welfare.	https://elearning.trree.org/
Gender Equality	Gender in Research - Toolkit and Training - Gender in research as a mark of excellence	The Gender in Research Toolkit and Training project strives to promote gender equality and excellence in scientific research by facilitating the participation of women scientists, promoting equal opportunities for women and men and integrating the gender dimension into research content in all research areas.	https://www.yellowwindow.com/genderinresearch/downloads/YW2009_GenderToolKit_Module1.pdf
	GEAR tool- Making a gender equality plan for academia and research	The Gender Equality in Academia and Research (GEAR) tool provides universities and research organisations with practical advice and tools through all stages of institutional change, from setting up a gender equality plan to evaluating its real impact.	http://eige.europa.eu/gender-mainstreaming/tools-methods/GEAR
	Practical Guide to Improving Gender Equality in Research Organisations	Research organisations have a crucially important role to play in addressing gender inequality; not only for the benefit of their own ecosystem, but to contribute to progress in wider society. This new publication sets out good practice examples and guides the further development of context specific approaches including how to avoid unconscious bias in peer review processes, how to monitor gender equality, and how to improve grant management practises	http://www.scienceeurope.org/wp-content/uploads/2017/01/SE_Gender_Practical-Guide.pdf
Governance	Guidelines on how to successfully design, and implement, mission-oriented research programmes	These guidelines address research programmes that set out a specific goal to tackle a societal problem through the means and opportunities provided by scientific and scholarly research – both from SSH and STEM. The expected research is often described as "mission-oriented", albeit usage of this term differs	https://www.ssh-impact.eu/guidelines-on-how-to-successfully-design-and-implement-mission-oriented-research-programmes/
	The precautionary principle: Definitions, applications and governance	The precautionary principle enables decision-makers to adopt precautionary measures when scientific evidence about an environmental or human health hazard is uncertain and the stakes are high. The precautionary principle is closely linked to governance. It raises a number of questions regarding risk governance (risk assessment, management and communication).	http://www.europarl.europa.eu/thinktank/en/document.html?reference=EPRS_IDA(2015)573876

Open Access	The FOSTER Open Science toolkit	FOSTER Plus has developed a set of ten free online courses covering key topics of Open Science.	https://www.fosteropenscience.eu/toolkit
	Ten steps to innovative dissemination	Research dissemination in the 21st Century isn't just articles, books and conference presentations. Open Science shows the way ahead towards dissemination that is participatory, innovative and reaches beyond the boundaries of academia.	https://zenodo.org/record/1302349#.W0b5yNL7TIU
	Open Science Toolbox | A Collection of Resources to Facilitate Open Science Practices	There is a vast body of helpful tools that can be used in order to foster Open Science practices. For reasons of clarity, this toolbox aims at providing only a selection of links to these resources and tools. Our goal is to give a short overview on possibilities of how to enhance your Open Science practices without consuming too much of your time.	http://www.osc.uni-muenchen.de/toolbox/index.html
	A Framework for Engaged Research: Society and Higher Education Addressing Grand Societal Challenges Together	Describes a wide range of rigorous research approaches and methodologies that share a common interest in collaborative engagement with the community and aim to improve, understand or investigate an issue of public interest or concern, including societal challenges. Engaged research is advanced with community partners rather than for or about them.	http://www.campusengage.ie/wp-content/uploads/2018/12/Framework for Engaged Research May 18 Web.pdf
Public Engagement	Public engagement: a practical guide. Involve the public. And involve them early	This is a practical guide for researchers on involving the public in working out how to communicate findings – from the earliest stages of projects, and on the most challenging of subjects. It draws on our experience of working with researchers on socially or scientifically difficult issues of public interest; particularly the Understanding Children's Heart Surgery Outcomes project.	https://senseaboutscience.org/wp-content/uploads/2017/11/Public-engagement-a-practical-guide.pdf
Science Education	Effective Science Communication | A practical guide to surviving as a scientist	"Effective Science Communication: A practical guide to surviving as a scientist" is devoted to the variety of ways that scientists are expected to communicate in their day-to-day professional lives. It includes practical advice on how to publish your work in scientific journals, apply for grants, and effectively communicate your research to both scientific and non-scientific audiences.	https://iopscience.iop.org/book/978-0-7503-2520-2
	Communication in Citizen Science - A practical guide to communication & engagement in citizen science	All citizen science projects have one thing in common; they all need good communication. Communication to recruit and engage citizen, to inform, to educate and to thank them after their participation. In this guide, you will find the building blocks for a communication plan, including an exercise to determine your project objective, your target audience and how to engage teachers. It also includes tactics and tools to promote initial and continued participation.	https://www.scivil.be/en/artikel/communicatiegids-burgerwetenschap
FAIR	FAIR-Aware assesment tool by the FAIRsFAIR project	FAIR-Aware is an online tool developed by the FAIRsFAIR project. It helps to assess your current level of awareness on making your datasets findable, accessible, interoperable and reusable (FAIR) before uploading them in a data repository. By guiding you through the assessment process, the tool will help you to better understand the FAIR Principles and how making data FAIR can increase the potential value and impact of your data.	https://fairaware.dans.knaw.nl/
	Final Report and Action Plan from the European Commission Expert Group on FAIR Data: Turning FAIR into Reality	This document is both a Report and an Action Plan for turning FAIR data into reality. It offers a survey and analysis of what is needed to implement FAIR in a broad sense and it provides a set of concrete recommendations and actions for stakeholders in Europe and beyond.	https://ec.europa.eu/info/sites/info/files/turning_fair_into_reality_0.pdf
Open Science	FIT4RRI Guidelines on Governance Settings for RRI & OSC	Guidelines on how to effectively embed RRI and OS in research organisations. The Guidelines do not purport to offer ready-made solutions but rather aims to propose a pathway for activating institutional change processes towards rri and Os in research organisations	https://fit4rri.eu/guidelines/

Appendix II: Self-Assessment Questions and Actions for Improvement

Key Thematic Element:	Self-Assessment Question	Diversity & Inclusion	Openness & Transparency	Anticipation & Reflection	Responsiveness & Adaptive Change	Actions for Improvement
Ethics focuses on (1) research integrity: the prevention of unacceptable research practices; and (2) science and society: the ethical acceptability of scientific and technological developments.	How do you ensure the integrity of your R&I practices?				✓	• Align practices with the Code of Conduct for Research Integrity in all phases, from research design to reporting results • Encourage critical peer review and internal discussion on research integrity throughout the process • Consult an external research ethics expert or ethics committee
	Who is involved in ethics-related reflection and decision-making for your R&I practices, and how?	✓	✓	✓	✓	• Engage with all R&I actors and beneficiaries (civil society organisations, local government, education community, customers, patients, families, etc.), through…
	How do you provide for different values, interests and ideals?	✓			✓	• Formulate strong guidelines protecting these principles • Resolve differences through rational arguments • Acknowledge different values, interests and ideals • Address conflicts of interest
	How do you prevent potentially harmful impacts on the public or the			✓	✓	• Anticipate the benefits and risks of our project • Ensure project outcomes are used responsibly even after the project
	What are possible strategies for preventing the negative implications of your R&I practices?		✓	✓	✓	• Be responsive to external inputs • Ensure transparency and open access from the beginning • Look long-term and anticipate possible negative side effects (for example, creating social inequality, being environmentally harmful)
	What are possible ethical considerations for you R&I practices?			✓	✓	• Anticipate impacts concerning: environment, human and animal health, local economic and development, social justice, education, and data
	Who should be responsible for the impacts of R&I?	✓	✓	✓		• Responsibility should be shared among all actors involved (scientists, policy makers, research institutions, universities, industry, civil society organisations, etc.), because… • Responsibility should lie with the individual researchers throughout the entire process, because…
	How may your work benefit from incorporating ethics?			✓		• Avoid possible research misconduct or market failure • Gain credibility • Improve quality by aligning our work with integrity principles and standards • Win greater support from other actors by being open, transparent and
Gender equality is about promoting gender balance in teams and in decision-making bodies, as well as considering always bodies, and considering always the gender dimension in research and innovation to improve the quality and social relevance of the results.	Does your project/ organisation have a gender equality plan?	✓	✓	✓	✓	• Describe and implement a gender equality plan • Add gender equality strategies to your overall strategy
	How do you address gender stereotypes?	✓		✓	✓	• Identify any gender stereotypes in your activities • Discuss what can be done to avoid gender stereotypes • Address biased attitudes, treatments and discrimination
	What are your organisation's gender equality practices regarding staff and working conditions?	✓			✓	• Aim for gender-balanced teams • Aim for gender-balanced management positions • Have family-friendly work spaces • Have equal salary guarantees • Have equal contract conditions • Promote awareness and support of diverse working approaches
	How is gender equality evaluated within your project/ organisation?	✓		✓	✓	• Draft specific actions and criteria for evaluating gender equality • Have a team dedicated to evaluating gender equality • Evaluate gender awareness through career development activities • Monitor gender balance of teams
	How is gender in education, communication or training supported at your organisation?	✓		✓	✓	• Provide gender equality training • Consider gender sensibility in our publications • Emphasise gender awareness in training activities • Stress gender awareness in all your activities
	How is gender equality addressed in your R&I practices?	✓		✓		• Have gender-balanced teams • Consider sex and gender in your chosen topics • Consider sex and gender in your methodology • Consider sex and gender in your data • Publicise gender-balanced strategies • Consider gender in your dissemination activities

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Governance is any form of coordination that fosters and mainstreams the process dimensions and outcomes of RRI within an organisation or in the interaction with others. It entails hard and soft multilevel structures, guidelines and arrangements with the aim to optimize our responsivity to societal challenges, needs and concerns and to consciously institutionalise responsible	What governance instruments does your organisation provide to foster shared responsibility in R&I?	✓	✓	✓	✓	• Following inclusion and diversity strategies • Making policies and strategies open and transparent to all actors involved • Responding to emerging knowledge, perspectives, views and norms, by... • Investing resources to make our innovations more responsive to societal needs and concerns • Employing an RRI governance plan
	Who is involved in setting your R&I agenda?	✓	✓	✓		• Involve management or advisory boards, funding organisations, different stakeholders, other teams and colleagues, and members of the public
	How are views from other research or societal groups included in your R&I practice?	✓	✓	✓		• Exchange views with peers, researchers and innovators from other disciplines • Talk with potentially affected groups and end users
	How do you ensure your R&I practices can adapt to unforeseen results or societal changes?		✓	✓	✓	• Be open to emerging societal needs • Change the research plan, if needed, in response to unforeseen results • Maintain dialogue with different stakeholders so you can change the practice as a response to critique or changed perspectives
	What resource allocations allow responsible improvements to your R&I practice?	✓		✓		• Provide time for reflection • Share experiences with others, internally or externally • Consult external experts in the fields of (for example, ethics, gender equality...) • Encouraging participation in RRI workshops and training
	What RRI-related training opportunities does your project/ organisation have (gender equality, ethics, open science, etc.)?	✓	✓	✓	✓	• Attend related conferences • Participate in relevant training • Develop training materials • Offer training
	What organisational changes are needed to adapt your R&I processes to stakeholders' input?		✓		✓	• Modify your science governance system so it responds to public demands • Create/implement structures that enable engagement • Set up incentive systems to encourage changes • Make accountability and transparency the bedrock of every stage • Practise open science
Open Access addresses issues of accessibility to and ownership of scientific information. Free and earlier access to scientific work might improve the quality of scientific research and facilitate fast innovation, constructive collaborations among peers and productive dialogue with civil society.	How does your organisation/ project approach open access policies?		✓	✓	✓	• Implemented open access policies
	How are open access policies integrated in your project/ organisation?		✓			• Include open access in your mission statement • Communicate your open access policies • Provide training on open access
	How transparent is the ownership of your work outcomes?		✓	✓		• Ensure clear and easily traceable ownership
	Which parts of your work are open access?		✓			• Consider/ ensure open access of: objectives, aims and goals, methodologies, data, preliminary results, final results, and uncertainties
	With whom do you share the results of your work?	✓	✓			• Share results with all actors involved or affected
	What framework conditions are made transparent to actors involved?		✓			• Ensure transparency concerning: structures for feedback and decision trails, interests and affiliations of all actors and/or financial means and
	How are your communication activities made accessible to diverse stakeholders?	✓	✓			• Ensure e-accessibility standards on your website • Ensure outreach activities are inclusive (regardless of gender, ethnicity, special needs, etc.) • Ensure events (training, workshops, meetings, etc.) have accessible

Key Thematic Element:	Self-Assessment Question	Diversity & Inclusion	Openness & Transparency	Anticipation & Reflection	Responsiveness & Adaptive Change	Actions for Improvement
Public Engagement: the process of R&I is collaborative and multi actor: all societal actors (researchers, citizens, policy makers, industry, educators, etc.) work together during the whole research and innovation process in order to align its outcomes to the values, needs and expectations of European society.	How do you involve stakeholders and the public in your work?	✓	✓			• Conduct outreach activities and reflect on them • Communicate regularly with different stakeholders • Regularly request feedback from affected actors • Incorporate the results of public consultations in your plans • Establish spaces for deliberation where projects can be run collaboratively
	What channels do you use to enable stakeholder participation in the R&I process?	✓	✓	✓		• Seek ongoing input and feedback from stakeholders • Seek collaboration of diverse stakeholders through co-creation methods • Leverage social media to promote reflection and get different voices involved • Offer public discussion sessions on R&I topics • Foster encounters between R&I institutions and the general public
	At which stage of the R&I process is it most effective for you to engage stakeholders, and why?	✓	✓			• Anticipate at which stage(s) you engage which stakeholders for what purpose
	What does public engagement in the decision-making process mean in your work or organisation?	✓	✓			• Encourage co-decision by different stakeholders, include civil society organisations • Legitimise the societal value of your research topics
	How do you tailor R&I processes to include stakeholders with different genders, ethnicities, classes, ages, routines, experience, or levels of power?	✓	✓			• Consider studies and consultations in your strategic plan • Run open consultations and include the results in our mission • Consider the needs of different groups in your programme development • Adapt the language according to the target group
	How do you ensure that stakeholders understand and accept their roles and the objectives of their engagement?	✓		✓	✓	• Provide clear statements about their roles and what they can expect from the results • Give briefings about public engagement to explain its benefits • Negotiate with stakeholders and members of the public on their
	What effects do your engagement activities have on public participants and on your R&I processes?			✓	✓	• Consider how you can improve participants' skills, empowering participants, facilitating better solutions for societal needs, and increasing legitimacy and social acceptance of research and science centres
	How do you address critical aspects of public engagement activities?	✓		✓		• Provide adequate time and human resources • Supply sufficient financial resources • Reflect on your own attitudes towards public engagement • Define the level of participation (for example, from consultation to co-decision)
Science Education focuses on (1) enhancing the current education process to better equip citizens with the necessary knowledge and skills so they can participate in research and innovation debates; and (2) increasing the number of researchers (promote	What motivates you to involve research-and-society issues in your science education projects?	✓	✓	✓	✓	• Support citizens in making informed decisions • Enable learners to play active roles in R&I processes • Help put STEM within its societal context • Increase stakeholder awareness that R&I can create solutions affecting their daily lives • Encourage stakeholder participation in R&I
	How do you encourage stakeholder participation in R&I?	✓	✓	✓		• Work on real-life challenges or current R&I projects involving STEM topics with ethical, legal or social aspects • Employ innovative teaching methods, such as inquiry-based learning, project-based learning, cooperative learning methods, etc. • Use diverse methodologies to engage different stakeholders, such as community based research, participatory governance initiatives, etc.
	How do you promote reflection on R&I in your science education activities?			✓		• Confer on different values, needs and perceptions, such as health inequality, animal welfare, fair investment… • Make room for deliberations on how to frame R&I questions • Discuss R&I methods and potential improvements to the R&I process • Analyse the roles of the different stakeholders
	How do you promote reflection on R&I's impacts (ethical, legal, economic, environmental, social) in your science education activities?			✓		• Ensure regular reflection sessions
	What stages of the R&I process are covered in your educational activities, and why?	✓	✓	✓		• Anticipate at which stage(s) you cover in educational activities and for what purpose
	How do you provide tailored information and education resources to specific stakeholder groups?	✓	✓	✓		• Utilise a variety of media • Adapt text according to target groups • Modify styles and formats according to target groups • Use different outreach channels (including innovative science communication formats)